Leg 106 treats: Hot vents, sea creatures, engineering feats

It was what happened on the seafloor surface, and not so much what was drilled from the crust below, that caused all the hoopla during Leg 106, the international Ocean Drilling Program's recent two-month cruise at the Mid-Atlantic Ridge. Scientists onboard the drillship *JOIDES Resolution* discovered, for example, black smokers — high-temperature hydrothermal chimneys — complete with an exotic array of sea creatures. This was the second such find on the floor of the Atlantic Ocean.

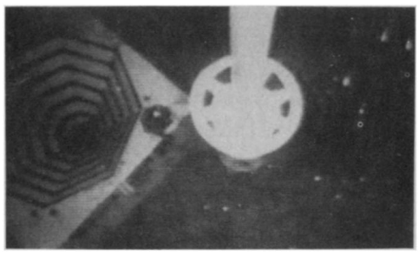
But apart from this, Leg 106 didn't produce much in the way of "earth-shaking new scientific results," says Robert Detrick, co-chief scientist on the leg. The real gem of the cruise was its successful testing of new drilling technologies, such as a 40,000-pound guide base that, when lowered onto the seafloor, enabled scientists to drill for the first time into bare rock. "Leg 106 is an important step forward in terms of developing the technology to begin a long-term investigation of [mid-oceanic] ridge crest environments," says Detrick, of the University of Rhode Island in Narragansett.

When scientists were outlining the scientific objectives of the Ocean Drilling Program (ODP) five years ago, they made drilling at mid-oceanic ridges their number one priority. These ridges — the "seams" of the world, where new seafloor is churned out and oceanic plates move apart — play host over a relatively narrow region to three very fundamental geologic processes — volcanic, tectonic and hydrothermal.

"If we drill right on the ridge chest, says Detrick, "then we have the opportunity to study these processes in action and to answer a number of questions," such as how the composition of magma (molten rock) changes with time and position along the ridge and whether the eruption of magma is periodic.

But drilling into volcanic rocks younger than a million years old has been very difficult. Young crust isn't covered by the thick layers of sediments needed by traditional drilling techniques to stabilize the drill string before the hole is spudded. And young volcanic rocks are highly fractured and abrasive, destroying drill bits rapidly.

Over the last year engineers addressed the first problem by developing the guide base deployed for the first time on Leg 106. At site 648, on the flat summit of a small volcano in the ridge valley, the ODP crew successfully used the guide base and some innovative drilling motors to spud a hole into the seafloor. Because of poor hole conditions and a diminishing supply of drill bits, however, they were able to drill to only 33 meters.



ODP

An image taken by the new video system at 3,344 meters underwater on the Mid-Atlantic Ridge shows the new guide base, which prevents the drill string from straying.

Another technical marvel of the cruise was a real-time video system that includes the same kind of high-resolution, low-light cameras used in the search for the *Titanic* (SN: 9/21/85, p. 182). The video system enabled the crew to watch the drilling operation and to position the drill bit with remarkable finesse. "This is really going to revolutionize drilling operations in the deep sea because it allows us to see what's going on on the seafloor," says Detrick. "It opens up enormous new possibilities in terms of being able to accurately position drill holes relative to seafloor geologic features," from submarine channels to deep-sea dunes.

The power of the technique was most aptly demonstrated at the second site of the cruise, site 649, where the scientific party drilled next to an 11-meter-high black smoker. The researchers were able to drill a series of 10 holes running away from this vent, with the closest hole drilled right at the foot of the chimney. "This is the first time anyone has drilled in one of these areas," says Detrick. One of the more surprising findings, he says, is that the hydrothermal deposits covering the seafloor are thick. The sediments next to the vent were at least 13 meters thick, and holes drilled 17 meters or more away from the vent went through at least 3 to 6 meters of hydrothermal deposits. The shipboard party also discovered lenses of very hard material made of iron and copper sulfides buried in the loose hydrothermal sediments.

The video cameras also recorded the sea life in the vent area. In general, says Detrick, the biological community living near site 649 seems to consist of smaller, more mobile organisms than those living in hydrothermal areas in the Pacific Ocean (SN: 1/12/80, p. 28). The recent find included shrimplike and eel-like swimming crustacea (leading the crew to dub the site the "Snake Pit") and possibly sea anemones, but none of the large tube worms, clams and mussels found in the Pacific. According to Peter Rona at the National Oceanic and Atmospheric Administration in Miami, the "Snake Pit" community appears to resemble those living near other Atlantic high-temperature vents that Rona and his colleagues discovered last summer 300 kilometers to the north of site 649. Detrick adds that Leg 106 scientists didn't have equipment for taking specimens, so they jury-rigged a device from fly screening and a 55-gallon drum to catch some of the shrimplike organisms.

ODP scientists report finding a dozen or so chimneys — most of which appeared to be inactive — in the 40,000 square meters of seafloor surveyed with the video system. Detrick says photographs taken of the sea bottom before the cruise suggested hydrothermal activity, but it wasn't until Leg 106 that scientists knew the exact location and extent of the chimneys and that the venting involved high temperatures, as evidenced by the black smokers. Some people used to "argue that high-temperature hydrothermal vents didn't exist in the Atlantic," says Detrick. "But with the discovery six months ago and this finding I think we've now dispelled that notion."

According to Detrick, the *JOIDES Resolution* will probably continue drilling at site 648 when it returns to the Mid-Atlantic Ridge this spring during Leg 109; the itinerary of Leg 109 is being finalized by ODP planners this week. At present the drillship is on Leg 107 investigating the opening of the Tyrrhenian Sea in the Mediterranean, west of Italy.

In addition to the successes of Leg 106, ODP planners and scientists are celebrating another event. The United Kingdom, which had been unable to raise the funds for joining the program last year (SN: 10/19/85, p. 247), has come up with the $2.5 million annual fee. The British formally agreed on Jan. 13 to join the program and to back-date their membership to the beginning of this fiscal year, in spite of the fact that British scientists had been barred from cruises last calendar year.

Now, with Canada, France, Japan, West Germany and the United States, the ODP has the required number of members. The United Kingdom "saved our bacon," says Garrett W. Brass, director of the ODP office at the National Science Foundation in Washington, D.C. "We now have the resources for a viable program for the long term."

— S. Weisburd